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Detecting Power Grid Synchronisation Failure on Sensing Frequency or Voltage beyond Acceptable Range

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Abstract*: Our project is designed to develop a system to detect the synchronization failure of any external supply source to the power grid on sensing the abnormalities in frequency and voltage. There are several power generation units connected to the grid such as thermal, solar etc to supply power to the load. If any deviation in voltage and frequency beyond the acceptable limit of the grid then the same feeder should automatically get disconnected from the grid. This prevents in large scale black out of the grid. So it is preferable to have a system which can warn the grid in advance so that alternate arrangements are kept on standby to avoid complete grid failure. So we are designing a system based on a PIC microcontroller which is the family of specialized microcontroller. The microcontroller monitors the under/over voltage using voltage sensors and is being derived from a set of comparators. As the frequency of the mains supply cannot be changed, the project uses a variable frequency generator (555-timer) for changing the frequency, while a standard autotransformer is used to vary the input voltage to test the functioning of the project. A lamp load (indicating a predictable blackout) is being driven from the microcontroller, in case of voltage/frequency going out of acceptable range and the fault indication will be indicated in the display.
Keywords: Voltage sensor, Frequency generator, Micro-controller, Lamp load, LCD Display

I. INTRODUCTION

An embedded system is a combination of software and hardware which is designed for one specific application in a time domain constraint. The best example of an embedded system is a mobile phone which performs the communication, along with the communication one can surf the internet, access the social network sites, play the games and even global positioning system is deployed into such a small device. The project is designed to develop a system to detect the synchronization failure of any external supply source to the power grid on sensing the abnormalities in frequency and voltage. There are several power generation units connected to the grid such as hydel, thermal, solar etc to supply power to the load. These generating units need to supply power according to the rules of the grid. These rules involve maintaining a voltage variation within limits and also the frequency. If any deviation from the acceptable limit of the grid it is mandatory that the same feeder should automatically get disconnected from the grid which by effect is termed as islanding. This prevents in large scale brown out or black out of the grid power. So it is preferable to have a system which can warn the grid in advance so that alternate arrangements are kept on standby to avoid complete grid failure. This system is based on a PIC microcontroller which area family of specialized microcontroller chips. The microcontroller monitors the under/over voltage being derived from a set of comparators. As the frequency of the mains supply cannot be changed, the project uses a variable frequency generator (555-timer) for changing the frequency, while a standard variac is used to vary the input voltage to test the functioning of the project. A lamp load (indicating a predictable blackout, brownout) being driven from the microcontroller in case of voltage/frequency going out of acceptable range Further the project can be enhanced by using power electronic devices to isolate the grid from the erring supply source by sensing cycle by cycle deviation for more sophisticated means of detection.

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II. DESIGN AND DEVELOPMENT OF THE SYSTEM

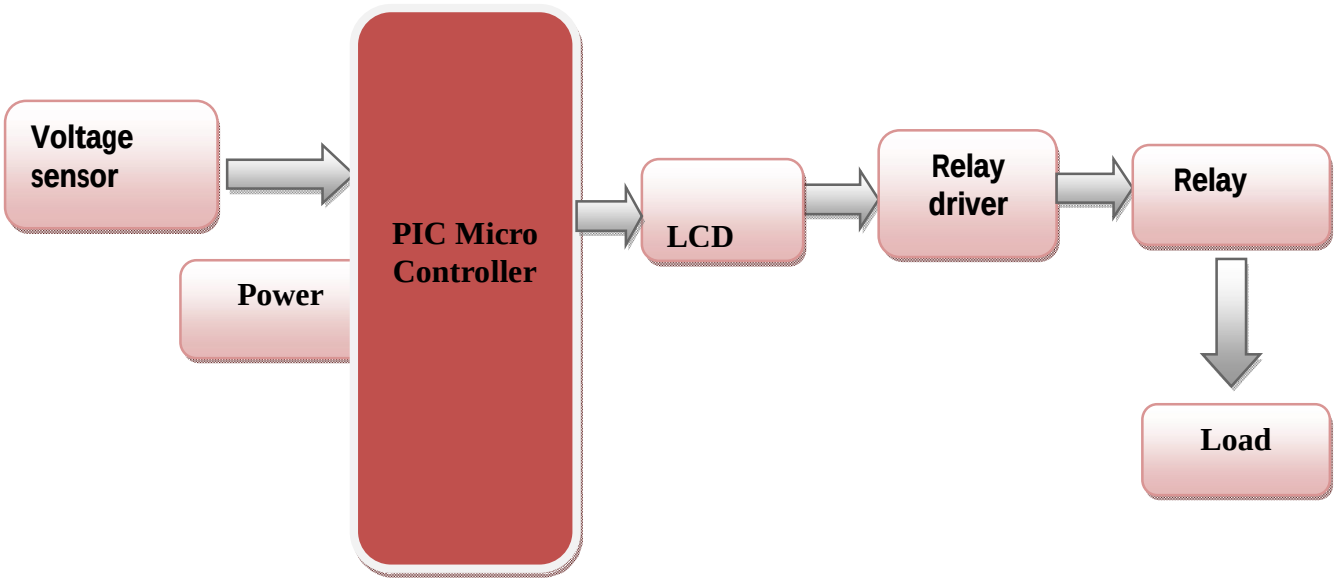

Fig: 1 Block diagram of the proposed system

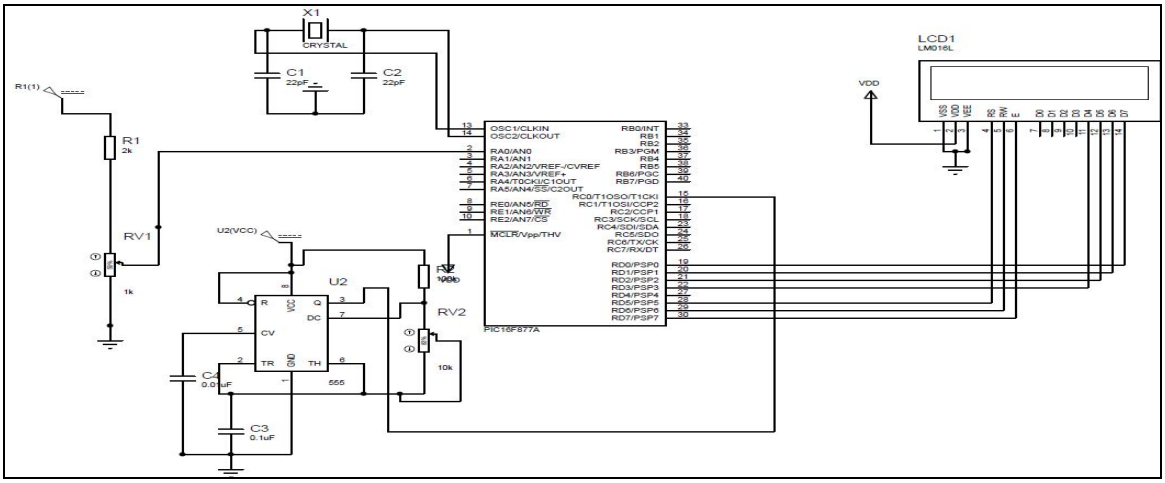

Fig:2 Circuit diagram of the proposed system

A. Hardware Requirement

1) *PIC Microcontrollers:* Microcontroller is the Heart of the Circuit. In this circuit we are going to use the PIC MCU. Microcontrollers are used in automatically controlled products and devices, such as automobile engine control systems, implantable medical devices, remote controls, office machines, appliances, power tools, toys and other embedded systems.
2) *LCD (Liquid Crystal Display):* The screen is an electronic display module and finds a wide range of applications. A 16x2 LCD display is very basic module and is very commonly used in various devices and circuits. These modules are preferred over even segments and other multi segment LEDs. The reasons being: LCDs are Economical; easily programmable; have no limitation of displaying special & even custom characters (unlike in seven segments), animations and so on.
3) *Power Supply Unit*: The power supply consists of step down transformer 230/12V, which steps down the voltage from 230V to 12V AC. This voltage is further converted into DC using Bridge Rectifier. The ripples are removed using a capacitor filter, this voltage is further regulated to 5V using a voltage regulator which is required for the operation of the microcontroller.

4) *Driver IC:* It is a high voltage and high current Darlington array IC. It contains open collector Darlington pairs with common emitters. A Darlington pair is an arrangement of two bipolar transistors. Recommended for high-side switching applications that benefit from separate logic and load grounds, these devices encompass load supply voltages upto 50 V and output currents to -500 mA. These 8-channel source drivers are useful for interfacing between low-level logic and high-current loads.
5) *Relay*: PCB mounting relay are used in the project for closing and connecting external load.
6) *Buzzer*: Piezo electric buzzer is used in the project for annunciation purpose.

B. Software Requirement

1) *CCS Complier:* Creates the high level design. From the features and performance desired, decide which PIC micro or PIC device is best suited to the application, then design the associated hardware circuitry. After determining which peripherals and pins control the hardware, write the firmware – the software that will control the hardware aspects of the embedded application. A language tool such as an assembler, which is directly translatable into machine code, or a compiler that allows a more natural language for creating programs should be used to write and edit code. Assemblers and compilers help make the code understandable, allowing function labels to identify code routines with variables that have names associated with their use, and with constructs that help organize the code in a maintainable structure.
2) Compiler, assemble and link the software using the assembler and/or compiler and linker to convert your code into "ones and zeroes" – machine code for the PIC micro MCU's. This machine code will eventually become the firmware (the code programmed into the microcontroller).

C. The Major Features of PIC Micro Controller:

1) It consists of only 35 single word instructions.
2) All single cycle instructions except for program branches are of two cycles.
3) Operating speed: DC - 20 MHz clock input.
4) DC - 200 ns instruction cycle.
5) Interrupt capability (up to 14 sources).
6) Eight level deep hardware stack.
7) Direct, indirect and relative addressing modes
8) Power-on Reset (POR), Power-up Timer (PWRT) and Oscillator Start-up Timer (OST).
9) Watchdog Timer (WDT) with its own on-chip.
10) RC oscillator for reliable operation.
11) Power saving SLEEP mode.
12) Selectable oscillator options.
13) Wide operating voltage range.
14) Provides commercial and Industrial temperature ranges.
15) Low-power consumption.
16) Low-power, high-speed CMOS FLASH / EEPROM technology.
17) 20 Megahertz crystal oscillator
18) 2.7-20pf capacitor
19) >7.2 volt battery
20) 7805 voltage regulator IC
21) A 16x2 LCD used for displaying in 5x7 pixels

III. ADVANTAGES AND DISADVANTAGES

A. ADVANTAGES

1) To provide the continuous supply for the betterment of NATION.
2) Safety against the natural disasters.
3) Easy to implement, reliable and flexible.
4) Cost effective and requires less maintenance and less time for performing the operation detection.
5) Grid is secured of power coming from different plants by detecting the abnormal conditions of frequency and voltages beyond

acceptable ranges.

6) It prevents synchronization failures between grid and feeder.

B. DISADVANTAGES

1) This detection process is totally depends upon the microcontroller so that, if microcontroller gets failed then the whole process will stop.

2) The detection is possible by sensors and controllers are used if, they may get stop the need of replacement.

IV. APPLICATIONS

A. This project is applicable for the solar power plants where frequency varies; frequency and voltage parameters should match with the power grid.

B. Microcontroller having various applications by changing the programming.

V. FUTURE SCOPE

We implement this project in order to provide continuous grid operation. Now a day there is a need of power with the proper utility. So, this paper gives the information about this system for the future use also. This is used to Detection any synchronization failure at power grid then it will sense or detect by sensors .It is by sensing the abnormal conditions of voltage or frequency beyond the acceptable range. By using the simple Assembly language programming microcontroller will control all operation. So that it is also economical for the future use. We use this system for detection as well as protection purpose also this is the main benefit and future scope of this system.

VI. CONCLUSION

In this way, to develop a system to detect the synchronization failure of any external supply source to the power grid on sensing the abnormalities in frequency and voltage. There are several power generation units connected to the grid such as hydro thermal, solar etc. to supply power to the load. The rules of grid involve maintaining a voltage variation within limits and also the frequency. If any deviation from the acceptable limit of the grid it is mandatory that the same feeder should automatically get disconnected. This prevents in large scale brown out or black out of the grid power by sensing abnormalities of voltage and frequency. This seminar is based on the microcontroller 8051.that are having lot of advantages by changing programming. So that alternate arrangements are kept on standby to avoid complete Grid Failure.

VII. ACKNOWLEDGEMENT

Now a days, there is a need of power with the proper utility. So, this paper gives the information about this system for the future use also. This is used to detection of any synchronisation failure at power grid then it will sense or detect by sensors. It is by sensing the abnormal conditions of voltage or frequency beyond the acceptable range, by using the simple assembly language programming microcontroller will control all operation. So that it is also economical for the future use. We use this system for detection as well as protection purpose also this is the main benefit and future scope of the system.

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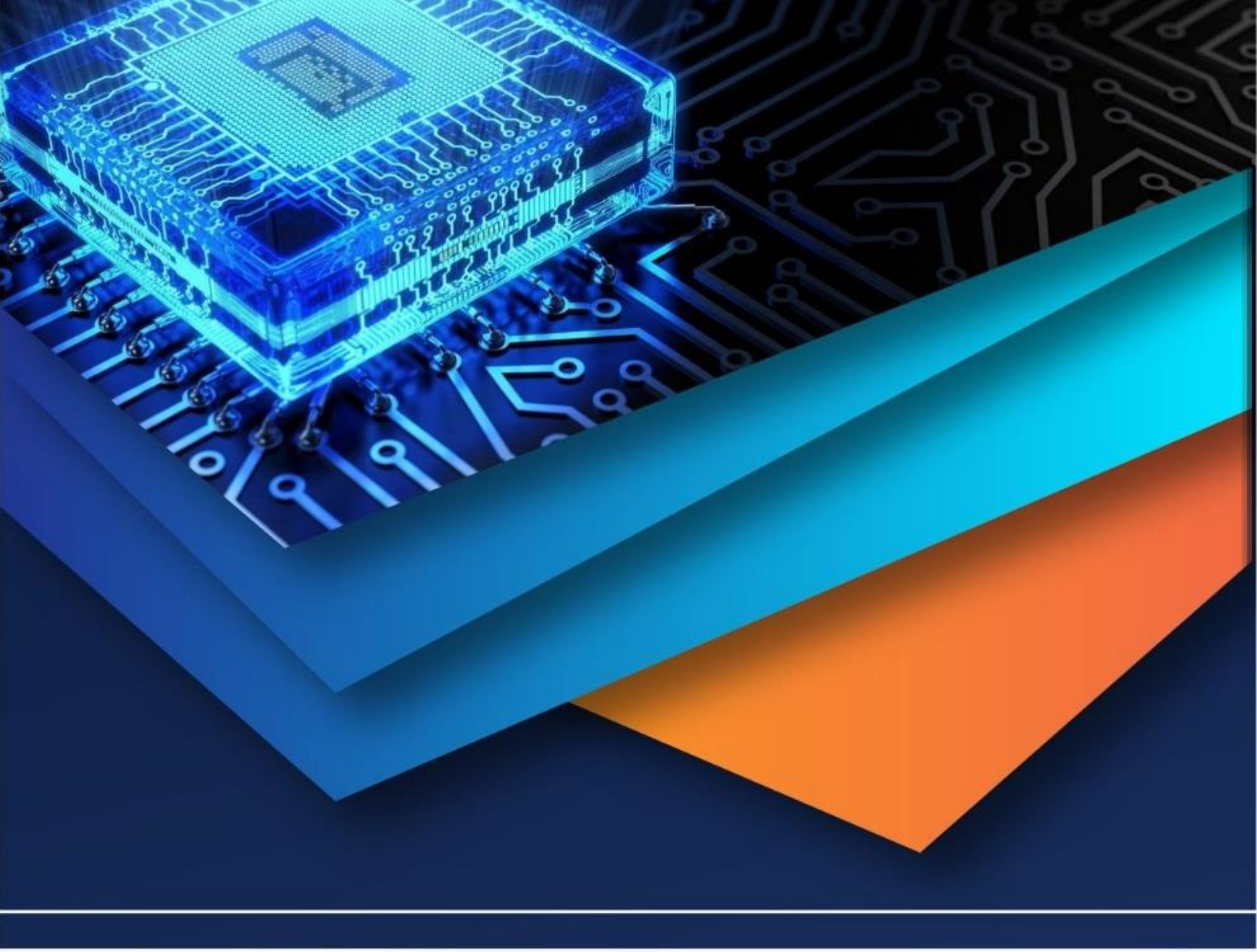

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